Customer-Led Network Revolution

Newsletter

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We're now into the final year of the Customer-Led Network Revolution project and I'm delighted to say that the foundations have been successfully put in place for an exciting 2014.

With our network technology trials well underway and our customer trials nearing completion, we are now in a position where we can look forward to sharing all of our valuable learning with the industry over the coming months.

Amongst the results to look forward to will be the publication of data from thousands of smart meter customers, giving an unprecedented insight into modern day load and generation profiles. We will also be releasing further analysis from our social science team. Hundreds of customers have contributed to this report, helping us to produce one of the largest studies ever recorded on consumer energy practices.

All the equipment for our network technology trials has been successfully installed and commissioned, including six electrical energy storage devices at strategic rural and urban locations across our network. These trials will continue throughout 2014, with a full range of findings to be published in the latter stages of the year.

However, perhaps the most important part of this project is the fact that we are not just looking at the value and effectiveness of each of our trials in isolation. What we're aiming to achieve goes far beyond that, and we're already starting to look at how we put all the pieces of the puzzle together to create a fully integrated smart grid solution. Towards the end of the year, our findings will be made readily available and presented in a way that can be easily absorbed into business as usual practices. This is a huge step forward in smart grid research which could help revolutionise GB electricity networks.

I hope you enjoy this edition of CLNR News and rest assured you'll be hearing from us more than ever as we embark on what is sure to be a defining year for this project.

Dr Liz Sidebotham
Editor

Making electricity networks fit for the future

Renewables and low carbon technologies are at the heart of the UK government's 2050 decarbonisation targets, but this cultural and technological shift will result in new patterns of energy consumption and generation that could have significant implications for Distribution Network Operators.

Chris Thompson
Northern Powergrid

Today's electricity networks were not designed to deal with widespread micro-generation or the mass uptake of electricity-dependent, low carbon technologies such as electric vehicles (EVs) and heat pumps. But network operators must find a way to help facilitate the transition to a low carbon economy and this is why Low Carbon Network Funded projects like the Customer-Led Network Revolution (CLNR) project were created – to uncover knowledge that can influence network design and help the industry manage future energy challenges.

To put this into perspective, it's estimated there are around 40 million cars on UK roads. If, at some point in the future, half of those were electric vehicles (EVs) and all those EV owners wanted to put their vehicles on charge at the same time, when they came in from work for instance, it would equate to 80GW of power, which is the entire generating capacity we have available in Britain today," says Chris Thompson, CLNR Project Delivery Manager at Northern Powergrid.

"When you take into account that the overall demand for electricity in the UK at the moment is typically 40GW or 60GW at peak, we'd have to double the existing generating capacity just to cope with EV demand alone.

"This is an extreme scenario, but it highlights how important projects like CLNR are to help us uncover the most practical and cost-effective ways to manage more and more low carbon technologies and renewable energy sources connecting to the grid.

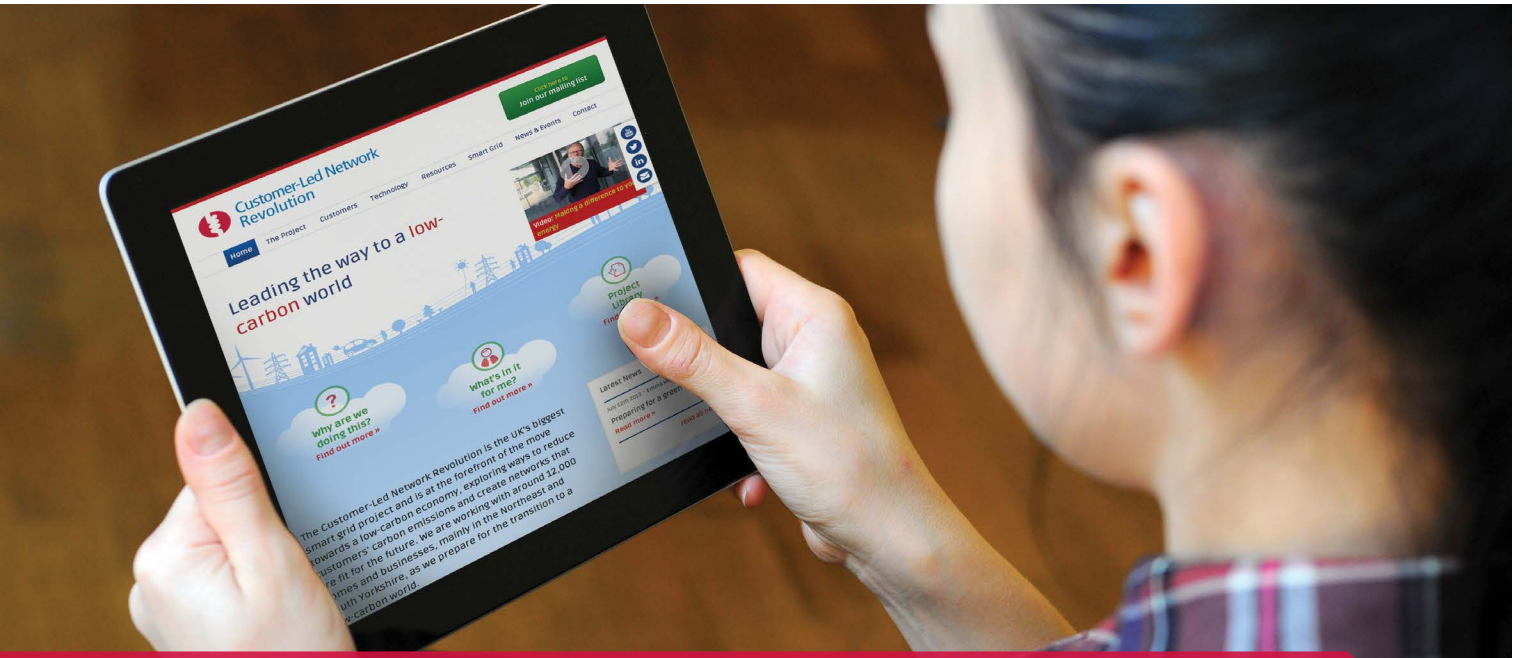
"For Distribution Network Operators, our findings will help them manage peak demand by maximising network efficiencies and minimising the need for network reinforcement. But customers will also benefit through more choice and flexibility over the way they use and generate electricity and a safe, secure and affordable supply of electricity now and in the low carbon future."

Real-world results

An important feature of the CLNR project is that trials are taking place on real networks and with real customers to produce real-world, usable data.

Chris says: "We purposely selected a range of rural and urban locations for our network technology trials to ensure our findings can be applied more across the UK. These locations combined offer a representative sample of 80% of Great Britain's total electricity distribution network, which means that the learning we gain from these trials will be applicable to 80% of GB networks.

"We're also working with thousands of electricity customers – many with low carbon technologies such as solar panels, heat pumps and electric vehicles – to better understand their energy consumption and the likely network impact of these new technologies. The overall aim of the customer trials is to help us understand whether customer flexibility, a range of innovative tariffs and new commercial arrangements can help balance waves of peak demand on the network. We've also produced one of the largest social science studies ever recorded on domestic energy consumption, and when you overlay this with robust trial data, you have an authoritative set of findings from which solutions can be drawn."



What to expect in 2014

We have now entered an exciting phase in the CLNR project where we are beginning to collate and analyse all our findings and when the pieces of the 'smart grid puzzle' will be brought together, using a complex active network management control system called GUS (Grand Unified Scheme).

Liz Sidebotham explains: "We'll be in a position later this year to look in depth, at how effective the various customer flexibility and network solutions we've been trialling have been in a range of different circumstances. More importantly, we'll be sharing this knowledge with other DNOs and the wider industry.

"Our demand side response trials are now well underway. We've already published interim findings from our first set of trials with industrial and commercial customers. We're now looking forward to sharing the results from the second round of DSR trials taking place in March and April 2014, with 16MW contracted through commercial aggregators and direct with a major customer."

Trials with domestic customers are also in full swing. As the host network operator, Northern Powergrid is sending signals to 'smart' washing machines installed as part of the project, asking customers to defer or reschedule their washes to outside periods of peak demand. Customers have the option to choose to follow these recommendations or continue as normal. These trials will give us a deeper understanding of customers' willingness to be flexible with their energy use and the role they can play in helping DNOs to shift and balance peak demand.

Our final social science report from the team at Durham University will provide even greater insight into consumers' energy behaviour and habits, as well as the receptiveness of customers to low carbon technologies, demand-side response and price incentives such as time-of-use (ToU) tariffs.

Website update

Liz adds: "We're also very pleased to be updating our website later this year, complete with an improved project library for easier access to reports and data. The new version will be much easier to use and will ultimately enhance visitor experience."

Throughout 2014 the CLNR team will continue to share knowledge and findings with other DNOs and industry experts at a variety of industry forums, events and speaking engagements as well as at our own CLNR stakeholder and knowledge sharing events.

For information on forthcoming events contact **info@networkrevolution.co.uk**

Social stats give insight into customer flexibility

Following the successful completion of a comprehensive recruitment drive by British Gas, we are collecting and analysing data from more than 9,000 smart meter customers.

Professor Harriet Bulkeley
Durham University

Their energy usage is being monitored and analysed as part of the CLNR project, to create an up-to-date set of load data which can be compared to the existing industry standards produced more than 30 years ago. This will give DNOs a better understanding of whether peaks in demand have changed due to the uptake in low carbon technologies or lifestyle adjustments in recent years, such as flexible working hours or changing domestic structures and give a much more accurate picture of UK energy consumption.

Durham University and National Energy Action have conducted more than 1,250 residential and 150 SME online customer surveys and around 250 in-depth, in-home interviews, to produce one of the largest studies of consumer energy practices ever recorded, providing valuable knowledge of how customers currently use energy, and how this might change in the future.

Social science academic at Durham University, Professor Harriet Bulkeley, says: "Our role on the project is to shed light on how people are responding to the various technologies being trialled, and the project is already creating new insights about how people are using smart meters and how they affect everyday activities.

"We have observed a very positive response to the in-home displays (IHDs), which customers have received with their smart meter. People quickly became used to the display, and sought to reduce their electricity use when it went into the 'red' zone of high use. Almost half of trial participants said that they engage with their smart energy monitor on a daily basis, even some months after it had been installed."

These surveys have highlighted that for many people, knowing more about their energy use through smart meters is a key tool in managing their household budget and having a greater sense of control.

Harriet explains: "Some people found it gave them a better understanding of the family's electricity use, leading to some frank exchanges of how that could be better managed, while others used the information to challenge themselves to save more energy.

"Perhaps most striking, however, is the potential that smart meters and IHDs have when paired with other products or services. For instance when used in conjunction with time-of-use (ToU) tariffs, smart appliances or micro-generation technologies, such as solar PV, the full functionality can be utilised; to postpone a wash cycle until outside a peak demand period or make the most out of solar power being generated for example."

Behavioural changes

ToU tariff trial participants have adapted their habits and altered their routines to manage their energy use and household finances more effectively, shifting household chores such as washing, hoovering and ironing to times outside of the peak hours, to maximise savings through the ToU tariff. A growing awareness of simple features built into ordinary household goods which allow people to shift their activities and reduce their energy consumption, such as timer switches and economy settings, has been a key factor in this.

Solar PV trial participants have been among the most engaged and informed. These customers tend to be the most aware of how the grid works and the role they can play. Most understand that it makes sense to make use of the free solar power they generate in the home rather than exporting it back to the grid.

"There's a sense of 'grow your own solar' amongst these energy citizens; a pride in being more self-sufficient. Customers are keen to use what they've generated themselves and so are changing their household habits, shifting daily chores into the middle of day, when PV generation is at its highest.

"On the whole, it seems that the role of smart meters within the CLNR smart grid project has helped to create a sense that people can make a difference to energy futures through more control of their own energy use, playing a role in 'keeping the lights on'. This has involved a shift from seeing themselves as 'energy consumers', to a situation in which they have a civic relationship with the grid – one in which they see the grid as a public good that we all have a stake in, in order to address the challenges of responding to climate change and securing new energy resources," concluded Harriet.

NPADDS – Helping to plan the electricity networks of the future

Network Planning and Design Decision Support (NPADDS) is one of the tools being developed by the CLNR project. NPADDS will help network planners and designers meet the challenges that the low carbon future will bring to the distribution network.

Dan Hollingworth
EA Technology Ltd

Developed by project partner EA Technology and designed to be used by network designers and planners, NPADDS is a web-based application that can be used to assess the network. Planners can assess where and when the network can support anticipated load, while designers can provide the most cost-effective solutions, both smart and conventional.

Daniel Hollingworth, Head of Smart Grid Delivery at EA Technology, said: "The core aspect of NPADDS is assessing whether existing transformers, power cables and other power assets are fit for purpose. The adoption of low carbon technologies means that DNOs have to consider a higher risk of overloads and voltage fluctuations beyond permitted levels – in other words, that the increased use of electricity might cause network failures.

"Outputs from trials have traditionally involved weighty reports that can be difficult for busy people to absorb and understand how to convert the valuable learning into changes to business practices. NPADDS will be a vital tool to demonstrate the outcomes from the project and help the conversion into business as usual adoption of the best ideas."

The tool has been specifically designed to be integrated into Northern Powergrid's existing data systems, informing decisions made about the management of network infrastructure. The potential load on the network is assessed by looking at low, medium or high uptake of a combination of three key low carbon technologies: electric vehicles, solar panels and heat pumps. By doing this, NPADDS can create a picture of how existing infrastructures will cope in a variety of scenarios.

The network assessment functionality of the tool has been completed, allowing the identification of network issues. The latest development is the launch of the 'Solutions Engine', which integrates the solution handling of the Transform™ investment scenario planning model. It provides support to network designers by providing a ranked list of solutions for an identified network constraint, as well as allowing the designer to develop solutions on the network model and perform detailed assessments.

NPADDS is positioning itself as a go-to tool for network designers and engineers, helping the UK to move towards a low carbon future with less risk and a calculated, planned approach to innovation and adaptation.

Read the paper submitted to CIRED 2013 on NPADDS here

CLNR Team Member Profile:

Allan Row, Project Manager for the CLNR Project at British Gas

With over ten years of experience in the electronics sector and a keen personal interest in technology, Allan Row has brought a wealth of knowledge to the CLNR project, helping to implement a range of customer trials.

A self-confessed 'gadget fanatic', he is also proud to be testing a variety of these technologies himself: Allan's own home resembles a prototype of the smart home of the future.

As someone interested in technology-led green living, Allan was keen to become an early adopter of innovative emerging technologies to experience them first-hand and ascertain how these technologies will help shape the energy industry's landscape.

Allan says: "Electronics and technology interest me, so these emerging low carbon and smart technologies that can help us all to save energy and decrease our carbon footprint are very appealing to me on a personal level. I've opted for a broad selection of different technologies, from a remote heating system (British Gas' Hive Active Heating), which enables me to remotely turn my heating and hot water on or off, up or down, via my smart phone to an EMMA unit, which helps make the most out of my solar panels by using excess energy to heat water through the immersion system.

"I've also had a micro-combined heat and power boiler installed, which is another form of micro-generation, and I'm using a smart washing machine on the energy supply control manager system. Using all of these technologies myself has certainly helped me develop a clearer understanding of low carbon technologies from the perspective of a consumer."

Trial data is still being gathered and analysed, but the findings to date suggest that customers understand the technologies they are trialling and they are also very receptive to smarter options.

Allan explains: "There has been a very low dropout rate across all the trials and engagement with smart meters has been particularly positive.

"Our tele-surveys, online surveys and email correspondence with trial participants have given us great insight into people's perceptions of smart meters smart energy monitors (in-home displays). They are easy to use and understand, and flexible too – customers can choose how to view their energy usage in pounds and pence, kWh or CO2 emissions over time – so the vast majority of people like them.

"They allow the customer to take greater control of their own energy use and the history function can be used to compare and set personal targets and budgets, ultimately empowering the customer.

"The popularity of the time-of-use (ToU) tariff is an important discovery, which could potentially result in ToU tariffs becoming more prevalent in the future. The findings to date suggest that 10% of peak energy consumption can be shifted through ToU, and we're able to reduce overall consumption by 3%. This mutual benefit – saving customers money and simultaneously allowing DNOs in the future to shift electricity use outside of the peak periods to ease constraints on the network – is important in the move towards a low carbon future."

The collaborative approach of the CLNR project partners has been a key driver in the project's success so far. Combining knowledge from different sectors of the industry and understanding customers' energy behaviour and flexibility is one of CLNR's key objectives.

Allan adds: "Co-operating with each other, sharing information and bringing our different perspectives together has been invaluable. For the purpose of customer recruitment the partnerships with Durham University and Newcastle University have been reassuring for customers.

"We're all from different business cultures but working in conjunction with one another will enable us to construct a toolkit of knowledge which can be used to develop a smarter grid and a lasting legacy," concludes Allan.

Our findings suggest that 10% of peak energy consumption can be shifted through time-of-use and we're able to reduce overall consumption by 3%. This mutual benefit – saving customers money and allowing DNOs in the future to shift electricity use outside of the peak periods is important in the move towards a low carbon future."

Watch a tour of Allan's smart home here

Putting together the pieces of the smart grid puzzle

Dave Miller
Northern Powergrid

The CLNR project is not solely about social science, or customer profiling, or new network technologies, it's about creating something that is much greater than the sum of its parts.

Individually, the various CLNR trials are providing industry-leading research that will help accelerate the move towards a low carbon economy but the key aim is to bring all these aspects together through a coherent smart grid approach, to make the network smarter by making the most of existing assets. Understanding how the combination of these various solutions will work together, using a complex Active Network Management (ANM) control system called GUS (Grand Unified Scheme) will ultimately minimise the need for network reinforcement.

Dave Miller, Northern Powergrid's CLNR Technical Architect, explains the potential benefits the project could bring to the UK energy sector: "Our research will help maximise energy supplier, network operator and customer efficiencies through the implementation of new smart grid technologies and solutions. Customers will benefit through greater control and flexibility over the way they use and generate electricity; suppliers will be able to better understand and engage with their customers, and Distribution Network Operators (DNOs) will be able to minimise losses, defer reinforcement, and create a more efficient and cost-effective network."

Smarter solutions that get the best out of existing assets are essential to control the scale of the network upgrade programme. Six electrical energy storage batteries of varying sizes have been connected to a live Northern Powergrid electricity network, to trial energy storage as a means of helping to manage peaks in demand for electricity. Data from these and other technologies, as well as customer flexibility and demand-side response, is being monitored and analysed by GUS.

DNOs are moving on from fit-and-forget arrangements to something smarter, particularly when connecting generation from onshore wind farms or solar farms for example, which has resulted in a new breed of clever control systems being developed. The Siemens GUS is one such system, used by Northern Powergrid with the ability to work out where network constraints are, make decisions on how to ease those constraints, and send out real-time set-points, based on real-time information on the state of the network.

"Whilst various network technologies are all important pieces of the smart grid puzzle, the GUS is what brings all the information from these together and analyses it as a whole. Essentially, GUS lets us use those new technologies in a coordinated manner, creating a truly integrated smart grid," explains Dave.

The difference between the GUS and some other ANM systems is the complexity of the black box, which is highly sophisticated. Whilst some control systems require the network planner to work out in advance where the constraints will be and place monitoring there, the GUS holds a full electrical model of the network, so it can identify constraints anywhere on the network.

"Many existing systems focus on turning generation down to avoid overloading assets whereas the GUS can assess voltage and overload, and it can control generation, load, batteries, static compensators and conventional on-load tap-changers. This means it can optimise the network, not just solving problems but also minimising both the energy lost on the network and the operational cost of these solutions.

"Through optimising the network, GUS can do more than simply avoid voltage and thermal constraints, it can even adjust voltages to reduce load, which will help the network cope with an unexpected loss of generation.

"Whilst some systems often need the network planner to work out all the scenarios in advance, the combination of real-time modelling to identify constraints and real-time optimisation to choose solutions means that the GUS can even solve unexpected problems.

"The GUS system signals a significant change in how the future network can and needs to work: it demonstrates that the grid can operate in a more effective and economical way," concludes Dave.

"Whilst various network technologies are all important pieces of the smart grid puzzle, the GUS is what brings all the information from these together and analyses it as a whole. Essentially, GUS lets us use those new technologies in a coordinated manner, creating a truly integrated smart grid."

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For enquires about the project
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